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U-Pb AGES AND Sr, Pb AND Nd ISOTOPE DATA FOR GNEISSES NEAR THE KOLAR SCHIST BELT: EVIDENCE FOR THE JUXTAPOSITION OF DISCRETE ARCHEAN TERRANES; E.J. KROGSTAD[1], G.N. HANSON[1], and V. RAJAMANI[2]
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Two Archean gneiss terranes in the Karnataka Craton of South India are separated by the narrow (3-8 km wide) Kolar Schist Belt, a zone of strong shearing. The largely granodioritic terranes have distinct U/Pb, Sm/Nd and Rb/Sr histories. Ages of plutonic rocks in the two terranes show minor differences, which are resolvable by U-Pb dating of small samples of zircon and of cores of single zircons, which have uncertainties of less than 10 Ma. The Kambha Gneiss, which is the major unit east of the Kolar Schist Belt has a U-Pb zircon age of 2532 Ma (Table 1). West of the belt, the granodioritic Dod Gneiss was emplaced at 2633 Ma (Table 1). This gneiss unit has inherited zircon cores which are older than 2800 Ma. The granodioritic Dosa Gneiss has an apparent magmatic age of 2613 Ma (Table 1). The Patna Granite, which is exposed north of the Kolar Gold Fields area, has a concordant zircon age of 2551 Ma.

Sphene U-Pb ages, perhaps indicating the time of cooling from igneous or high grade metamorphic events, are 2521 Ma east of the schist belt and 2553 Ma west of the Belt. This age difference for adjacent gneiss terranes suggests that the terranes had separate histories until after 2520 Ma.

The Sm/Nd, Rb/Sr and U/Th/Pb histories of these two granodioritic gneiss terranes are also quite different. East of the Schist Belt 2530 Ma gneisses have initial Nd, Sr and model initial Pb ratios (Table 1) which are consistent with derivation from a source with limited, if any, crustal history. On an epsilon Sr - epsilon Nd diagram (Fig. 1), these gneiss samples lie along a steep negative slope similar to data from: a) rocks derived from present day subcontinental mantle; or b) mixing of melts derived from depleted mantle with those from a long-term, low Sm/Nd and low Rb/Sr reservoir, such as the lower crust. The Pb data do not, however, indicate that one of the sources of the Kambha Gneiss is an old, low U/Pb, high Th/U reservoir such as lower crust. These primitive initial Nd, Sr and Pb ratios allow only a short-lived crustal history for the sources of these gneisses east of the Schist Belt. These constraints contrast with some models for the evolution of the Dharwar craton which suggest that no new crust was formed after 3000 Ma.

West of the Kolar Schist Belt the chemically primitive 2633 Ma Dod Gneiss has Nd, Sr and model Pb initial ratios (Table 1) which range from mantle-like to those showing evidence of a crustal influence. The 2613 Ma Dosa Gneiss which occurs in the same area has initial Nd, Sr and model initial Pb ratios (Table 1) which show a stronger crustal influence than those of the Dod Gneiss. K-feldspar Pb data from samples of the Dod and Dosa gneisses and the 2551 Ma Patna Granite lie along a correlation line with a slope age of 3200 to 2600 Ma, with a lower intercept with a model mantle (u_1 = 8.0) at 2600 Ma (Fig 2). On an epsilon Sr - epsilon Nd diagram (Fig. 1), data from the Dod and Dosa gneisses lie along a line with a slope much more shallow than that for the Kambha Gneiss samples. These data suggest that the magmatic precursors of these gneisses included mixtures of material derived from mantle sources depleted in incompatible elements and significantly older upper crustal material.

One possible candidate for the source of the crustal contaminant is the source of a felsic rock which is found as a pod-like body in the shear zone west of the schist belt. This sample has K-feldspar with extremely radiogenic Pb, and has very radiogenic Sr, and unradiogenic Nd (Banded Gneiss, Table 1). Zircon cores from this rock include an inherited component older than 3170 Ma. Another possible contaminant is represented by a granitoid inclusion from a inclusion-rich horizon of the Champion Gneiss. This rock has discordant zircons which have minimum ages of 2900 Ma. This rock has also very evolved K-feldspar Pb and unradiogenic Nd (Champion Inclusion, Table 1). The K-feldspar Pb compositions of these two samples lie on, or near, the 3200 to 2600 Ma line fitting the Dod and Dosa gneiss K-feldspar data (Fig. 2). These data suggest that these felsic samples may be fragments of an evolved, older, continental crust which is apparently absent immediately east of the belt.

Assuming that the juxtaposition of the terrannes was accompanied by a metamorphic event affecting the belt and the gneisses on both sides of the belt, because the sphenes from either side give different U-Pb ages the metamorphism was not intense enough to similarly reset the sphene ages on both sides. Thus the juxtaposition of the terranes probably postdated the sphene (cooling) age of the eastern Kambha Gneiss (2521 Ma). K-feldspar - whole rock Pb-Pb ages, which have closure temperatures less than that for sphene, range from 2450 to 2300 for samples on both sides of the belt. These ages are similar to the 2420 $\pm$ 12 Ma $^{40}Ar/^{39}Ar$ plateau age on muscovite from a sample from the western shear zone, which is the age (or a minimum age) for the time of shearing of the gneisses, which occurred after the terranes were juxtaposed.

TABLE 1

unit	zircon age (Ma)	sphene age (Ma)	epsilon Sr	epsilon Nd	source model mu(1)
WEST					
Dod Gneiss	2633 (+/-8)	2553 (+/-2)	+19, +30	+1.7 to -1.0	8.7 to 9.2
Dosa Gneiss	2613 (+/-10)		+40. +45	-1.0 to -3.5	8.7 to 9.2
Patna Granite	2551 (+/-2.5)	2553 (+/-2)			10
POSSIBLE WEST BASEMENT					
Banded Gneiss	>3170		+318 (at 2600 Ma)	-4.5 (at 2600 Ma)	~35 (3200-2600 Ma)
Inclusion, Champion Gn.	>2900			-7.5 (at 2600 Ma)	~15 (3200-2600 Ma)
EAST					
Kambha Gneiss	2532 (+/-3)	2521 (+/-2) 2514	-2 to -4	+4.5 to 0.0	8.0 to 8.2

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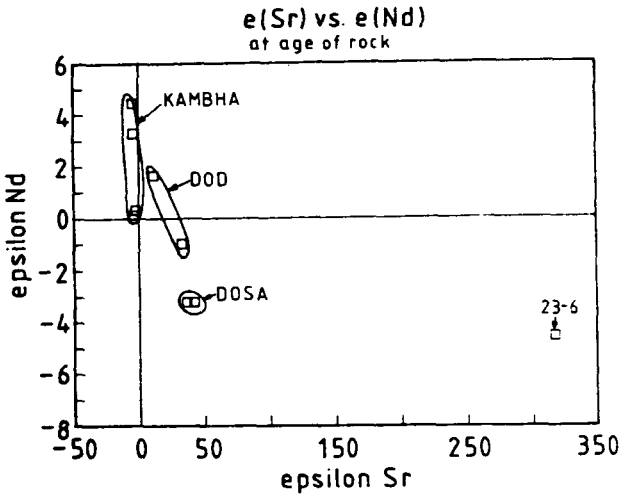

Figure 1. Epsilon Sr versus epsilon Nd diagram showing samples from the Kambha Gneiss at 2530 Ma and the Dod and Dosa gneisses at 2600 Ma. Also shown is the Banded Gneiss sample (23-6) from the shear zone on the western side of the schist belt. The eastern samples lie in the field of depleted mantle, with a steep slope which does not suggest contamination by an old, high Rb/Sr crust. The western samples range from similar values of epsilon Nd to points which suggest that an older, high Rb/Sr and low Sm/Nd crust was among their sources. The Banded Gneiss sample may represent part of such an older crust.

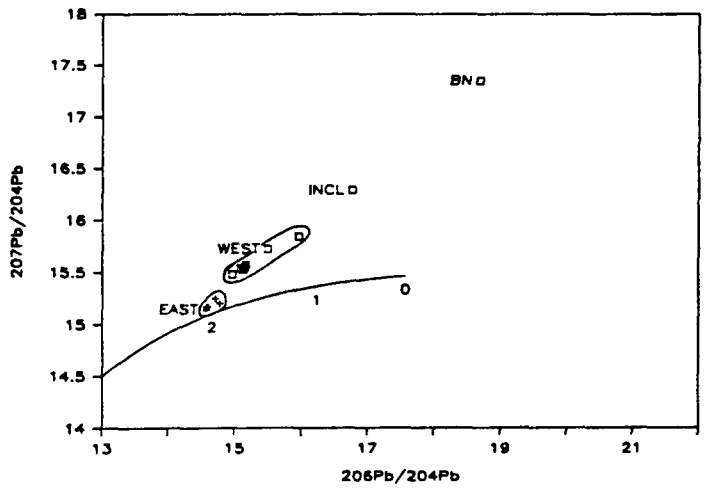

Figure 2. Pb isotopic composition of residues of leached K-feldspars from the major gneiss units. Kambha Gneiss samples lie in a restricted field with low $^{207}Pb/^{204}Pb$ values, consistent with a lack of significantly older crust on the east side of the schist belt. Samples from the west side of the belt lie along a line with a steep, positive slope which can be interpreted as a mixing line between old, crustal Pb, represented by the Banded Gneiss ("BN") and Champion Gneiss Inclusion ("INCL") points, and a more primitive, "mantle-like", Pb composition. The slope of this line has an age of 3200-2600 Ma.